Scanning SQUID Microscope Imaging of Excess Vortex Density in Field-cooled MoGe Films with Surface Trenches

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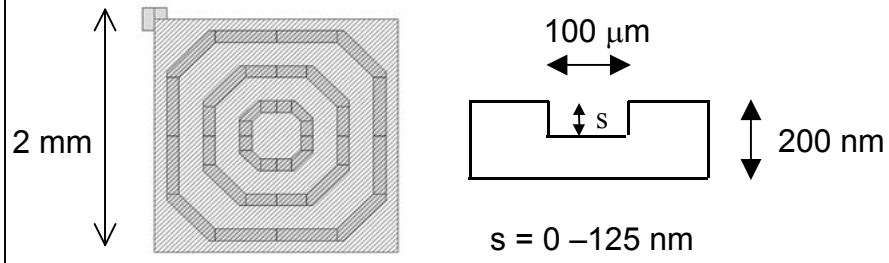
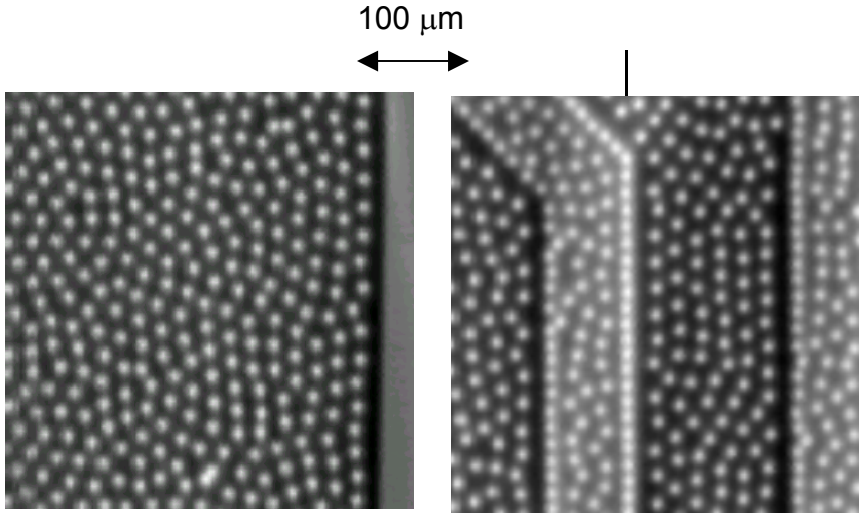
Motivation: Determine the effect of surface steps and defects on the distribution and dynamics of magnetic vortices in weak-pinning superconducting films

Approach: Scanning SQUID Microscope (SSM) images of the vortex density of amorphous-MoGe thin films patterned into squares and with trenched ion-milled into surface to simulate surface steps



Results:

- Vortex pattern with six-fold orientation but no long-range order even at low fields (<0.1G)
- Repulsion of vortices from trench edge
- Alignment of vortices on inside trench edge
- Excess net vortices in entire sample compared to applied field → paramagnetic Meissner effect



SSM images of vortex distributions in MoGe films without and with surface trenches at B=30mG

Scanning SQUID Microscope Imaging of Excess Vortex Density (cont'd)

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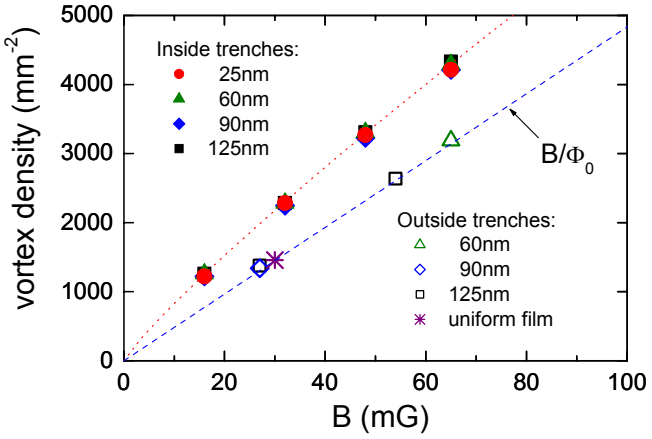
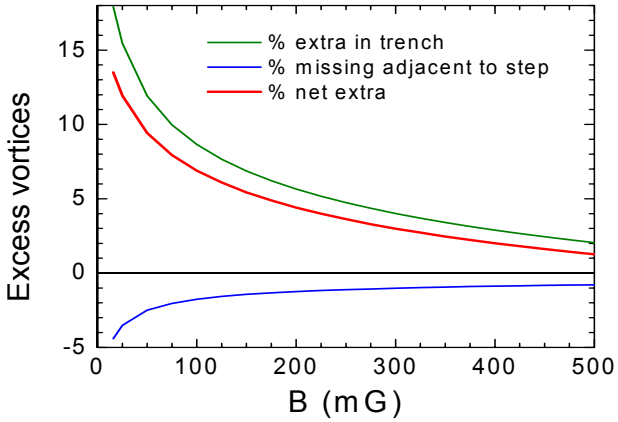
Experiments:

- Density of vortices inside trench is enhanced compared to the applied field density B/Φ_0 --- enhancement is independent of trench depth



- Excess vortices in trench exceeds depletion outside the trench edges → net excess of vortices relative to expected density B/Φ_0



Conclusions: anomalous vortex density enhancement, a new paramagnetic Meissner effect ... origin may be screening currents or Type-III superconductivity along step edges

Personnel:

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